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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/524,038	02/09/2005	Kiyotaka Ishibashi	265770US26PCT	4852

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EXAMINER	
DHINGRA, RAKESH KUMAR	

ART UNIT	PAPER NUMBER
1792	

NOTIFICATION DATE	DELIVERY MODE
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Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Notice of the Office communication was sent electronically on above-indicated "Notification Date" to the following e-mail address(es):

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Office Action Summary	Application No.	Applicant(s)	
	10/524,038	ISHIBASHI ET AL.	
	Examiner	Art Unit	
	RAKESH K. DHINGRA	1792	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE *03* MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *18 September 2008*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1,5-7,9-11,15,18,19,23 and 24* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1,5-7,9-11,15,18,23,24* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☒ The drawing(s) filed on *15 October 2007* is/are: a)☒ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☒ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)

2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)

3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.

4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____ .

5) ☐ Notice of Informal Patent Application

6) ☐ Other: _____.

DETAILED ACTION

Response to Arguments

Applicant's arguments with respect to claims 1-20 have been considered but are moot in view of the new ground(s) of rejection as explained hereunder.

Applicant has amended claims 1, 11, 19 by adding new limitation (e.g. in claim 1 new limitation "such that all microwaves irradiated towards the inside of the chamber 1 are introduced through the slots of the slot antenna 6 and the top plate" has been added. Further, applicant has added new claims 23, 24.

Accordingly claims 1, 5-7, 9-11, 15, 18, 19, 23 and 24 are now pending and active.

New reference by Mabuchi et al (US 6,091,045) when combined with Kazumi et al and Chen et al reads on amended claim 1 limitations including the newly added limitation "such that all microwaves irradiated towards the inside of the chamber 1 are introduced through the slots of the slot antenna 6 and the top plate". Accordingly claims 1, 5-7, 9 and 10 have been rejected under 35 USC 103 (a) as explained below. Further, Kazumi et al when combined with Mabuchi et al and a new reference by Ohmi et al (US 2002/0020498) reads on amended claim 11 limitations. Accordingly claims 11, 24 have also been rejected under 35 USC 103 (a) as explained below. Balance claims 15, 18, 19 and 23 have also been rejected under 35 USC 103 (a) as explained below.

Regarding applicant's arguments that the record is devoid of evidence that the thickness of the sidewall portion as recited in claim 1 is recognized by Chen as a result effective variable, examiner responds that Mabuchi teaches that by selecting the shape of recess in top part 14, that is, optimizing the cross-section profile of the microwave window (which would obviously include the geometry of the side wall portion of the top plate 14), it is possible to control the

plasma density distribution across the substrate surface. Additionally Chen teach that the top part of Fig. 4 which includes a sidewall portion, enables to increase the peripheral electric field resulting in improved plasma uniformity (col. 9, lines 34-54). Chen also teach that dimensions of cross-section of window 100 are optimized to increase microwave electric field at the peripheral portion of the top part 100 and enables to obtain improved plasma uniformity (col. 10, line 19 – col. 11, line 23). It would be obvious to optimize the geometry of the top part (which would include the side wall portion) as a result effective variable, in view of above teachings of Mabuchi and Chen. to obtain improved plasma uniformity. Thus, Kazumi et al in view of Mabuchi and Chen teach all limitations of claim 1 as explained above.

Claim Rejections - 35 USC § 103

The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office action:

(a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out

the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

Claims 1, 5-7, 9 and 10 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kazumi et al (JP 2000-331998) in view of Mabuchi et al (US 6,091,045) and Chen et al (US 5,234,526).

Regarding Claim 1: Kazumi et al teach a plasma apparatus comprising:

a chamber 20 for accommodating a substrate 27;

a dielectric top plate unit 23 disposed in an upper portion of the chamber;

an antenna 50 having a plurality of slots 50A for irradiating a microwave towards an inside of the chamber 26 through the top plate member 23, the antenna 50 being disposed on the top plate member 23 and being in close contact therewith;

a gas injection opening 29 for supplying a processing gas into the chamber; and a vacuum pump for exhausting the inside of the chamber through exhaust outlet 30 ,

wherein the top plate member 23 includes:

a dielectric flat plate portion 23A formed to face the substrate; and

a dielectric sidewall portion 23B formed to extend from a peripheral region of the flat plate portion 23A towards the substrate (e.g. Fig. 3 and para. 0023-0026 and 0030-0035).

Kazumi et al do not teach wherein sides of the flat portion and the sidewall portion facing a plasma generation region have a curved surface extending between the flat plate portion and the sidewall portion and the sidewall portion has a thickness not smaller than $\lambda g/4$ but not greater than λg , λg being a wavelength of the microwave, and

wherein the microwave propagates from the flat plate portion to the sidewall portion and then is supplied towards a periphery portion of the substrate, thereby enhancing a uniformity of a plasma density in a radial direction of the substrate.

Mabuchi et al teach a plasma apparatus comprising a top part 14 (dielectric window) that includes a dielectric flat plate portion formed to face the substrate and a dielectric sidewall portion formed to extend from a peripheral region of the flat plate portion towards the substrate. Mabuchi et al further teach that the sides of the flat portion and the sidewall portion facing a plasma generation region can have a curved surface extending between the flat plate portion and the sidewall portion. Mabuchi et al additionally teach that by selecting the shape of recess, that is optimizing the cross-section profile of the microwave window, it is possible to control the plasma density distribution across the substrate surface (e.g. Fig. 7 and col. 5, lines 10-45). It would be obvious to optimize the profile of recess in the dielectric window as a result effective variable, as per teaching of Mabuchi in the apparatus of Kazumi et al to obtain a desired plasma density distribution. Further, the microwaves would obviously flow from the flat plate portion of the top plate 14 to the side wall portion and then supplied towards the substrate (including the peripheral portion of the substrate). Further still, as already indicated above, Mabuchi et al also teach that by optimizing the cross-section profile of the top plate 14 the plasma processing uniformity can be improved in the radial direction.

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to optimize the profile of recess in the dielectric window, as taught by Mabuchi et al in the apparatus of Kazumi et al to obtain a desired plasma density distribution for improving plasma uniformity.

Kazumi et al in view of Mabuchi et al do not teach the sidewall portion and the sidewall portion has a thickness not smaller than λg/4 but not greater than λg , λg being a wavelength of the microwave.

Chen et al teach a plasma apparatus with a gas injection opening 38, an evacuation opening 3a (normally connected to a vacuum pump) and further comprising a top plate unit with a flat plate portion and a side wall portion that extends towards a substrate. Chen et al further teach that window can also be made in two pieces like a flat plate portion 100c and a curved piece 100d, so that the sides of the flat portion and the sidewall portion facing a plasma generation region have a curved surface extending between the flat plate portion and the sidewall portion (e.g. Fig 6b). Chen et al also teach that the shape of window with the sidewall (Fig. 4) results in a relative increase of peripheral field electric field and enhanced homogeneity of plasma. Chen et al also teach that geometry and material properties of the dielectric top plate are optimized to optimize the microwave distribution in the chamber, and also as per required microwaves modes. Chen et al additionally teach that as an example (Fig. 3) for proper matching, the thickness of the dielectric top plate 9 is made equal to ¼ times lambda.g, multiplied by an integer. It would be obvious to optimize the geometry of top plate that is, shape of recess or cross-section profile including the side wall portion (as a result effective variable) as per teaching of Mabuchi et al and Chen et al to control and optimize the plasma distribution in the process chamber (e.g. Figs. 3, 4, 8, 14a and col. 8, lines 50-68 and col. 12, lines 60-68 and col. 15, line 44 to col. 16, line 25).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to optimize the shape and thickness of the side wall portion of the top plate as taught

by Chen et al in the apparatus of Kazumi et al in view of Mabuchi et al to control and optimize plasma density distribution and obtain uniform plasma in the process chamber.

In this connection courts have ruled:

It would have been obvious to one having ordinary skill in the art to have determined the optimum value of a cause effective variable through routine experimentation in the absence of a showing of criticality. *In re Woodruff*, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Regarding Claim 5: Kazumi et al teach gas injection opening 29 for supplying gas into chamber along the side wall portion (Fig. 3).

Regarding Claims 6, 10: Chen et al teach that an outer periphery of side wall portion 120b is covered with a conductor 124 (metal wall of the chamber) without any gap (Fig. 14a).

Regarding Claim 7: Chen et al teach that inner shape of the dielectric top plate unit 120 is bell-jar type (Fig. 14a).

Regarding Claim 9: Kazumi et al teach a gap 25 between the side wall portion 23 and the conductor 20 (metal chamber wall) [Fig. 3 and para. 0023].

Claims 11, 24 are rejected under 35 U.S.C. 103(a) as being unpatentable over Kazumi et al (JP 2000-331998) in view of Mabuchi et al (US 6,091,045) and Ohmi et al (US 29002/0020498).

Regarding Claim 11: Kazumi et al in view of Mabuchi et al teach all limitations of the claim (as already explained above under claim 1) including a dielectric top plate unit having a flat plate portion and a side wall portion, and wherein sides of the flat portion and the sidewall portion facing a plasma generation region have a curved surface extending between the flat plate portion

and the sidewall portion, and a slot antenna in close contact with the dielectric top plate unit. Further, in the apparatus of Mabuchi et al the microwaves would obviously flow from the flat plate portion of the top plate 14 to the side wall portion and then supplied towards the substrate (including the peripheral portion of the substrate).Additionally Mabuchi et al also teach that by optimizing the cross-section profile of the top plate 14 the plasma processing uniformity can be improved in the radial direction (Mabuchi et al – Fig. 7 and col. 5, lines 10-45).

Kazumi et al in view of Mabuchi et al do not teach a gap distance between the top plate unit and the antenna being equal is smaller than lambda g/10, lambda g being a wavelength of microwaves.

Ohmi et al teach a microwave plasma apparatus with a slot antenna 6 that is disposed above a dielectric top plate 2 with a gap d1, wherein the gap is set to be around 6 mm, which is smaller than lambda./10 (that is 1.22 cm) so as to obtain improved plasma density [e.g. Fig. 1 and para. 0035).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide a gap that is equal to or smaller than lambda/10 between the antenna and the dielectric top plate, as taught by Ohmi et al in the apparatus of Kazumi et al in view of Mabuchi et al to obtain improved plasma density on the processing chamber.

Regarding Claim 24: Ohmi et al teach that all microwaves irradiated towards the inside of the chamber are introduced through the slots and the top plate (Ohmi et al – Fig. 1).

Claim 15 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kazumi et al (JP 2000-331998) in view of Mabuchi et al (US 6,091,045) and Ohmi et al (US 29002/0020498) as applied to claim 11 and further in view of Chen et al (US 5,234,526).

Regarding Claim 15: Kazumi et al in view of Mabuchi et al and Ohmi et al teach all limitations of the claim including that by selecting the shape of recess in the top part, that is, by optimizing the cross-section profile of the microwave window, it is possible to control the plasma density distribution across the substrate surface (Mabuchi et al - Fig. 7 and col. 5, lines 10-45).

Kazumi et al in view of Mabuchi et al and Ohmi et al do not teach the sidewall portion has a thickness not smaller than λg/4 but not greater than λg , λg being a wavelength of the microwave.

Chen et al teach a plasma apparatus with a gas injection opening 38, an evacuation opening 3a (normally connected to a vacuum pump) and further comprising a top plate unit with a flat plate portion and a side wall portion that extends towards a substrate. Chen et al further teach that window can also be made in two pieces like a flat plate portion 100c and a curved piece 100d, so that the sides of the flat portion and the sidewall portion facing a plasma generation region have a curved surface extending between the flat plate portion and the sidewall portion (e.g. Fig 6b). Chen et al also teach that the shape of window with the sidewall (Fig. 4) results in a relative increase of peripheral field electric field and enhanced homogeneity of plasma. Chen et al also teach that geometry and material properties of the dielectric top plate are optimized to optimize the microwave distribution in the chamber, and also as per required microwaves modes. Chen et al additionally teach that as an example (Fig. 3) for proper matching, the thickness of the dielectric top plate 9 is made equal to ¼ times lambda.g, multiplied by an integer. It would be obvious to optimize the geometry of top plate that is, shape of recess or cross-section profile including the side wall portion (as a result effective variable) as per teaching of Mabuchi et al and Chen et al to control and optimize the plasma distribution in

the process chamber (e.g. Figs. 3, 4, 8, 14a and col. 8, lines 50-68 and col. 12, lines 60-68 and col. 15, line 44 to col. 16, line 25).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to optimize the shape and thickness of the side wall portion of the top plate as taught by Chen et al in the apparatus of Kazumi et al in view of Mabuchi et al and Ohmi et al to control and optimize plasma density distribution and obtain uniform plasma in the process chamber.

In this connection courts have ruled:

It would have been obvious to one having ordinary skill in the art to have determined the optimum value of a cause effective variable through routine experimentation in the absence of a showing of criticality. *In re Woodruff*, 16 USPQ2d 1934, 1936 (Fed. Cir. 1990).

Regarding Claim 18: Chen et al teach that inner shape of the dielectric top plate unit 120 is bell-jar type (Fig. 14a).

Regarding Claim 19: Kazumi et al teach gas injection opening 29 for supplying gas into chamber along the side wall portion (Fig. 3).

Claim 23 is rejected under 35 U.S.C. 103(a) as being unpatentable over Kazumi et al (JP 2000-331998) in view of Mabuchi et al (US 6,091,045) and Chen et al (US 5,234,526) as applied to claim 1 and further in view of Ohmi et al (US 29002/0020498).

Regarding Claim 23: Kazumi et al in view of Mabuchi et al and Chen et al l teach all limitations of the claim except that all microwaves irradiated towards the inside of the chamber are introduced through the slots and the top plate.

Ohmi et al teach a microwave plasma apparatus with a waveguide 7, a slot antenna 6 is disposed above a dielectric top plate 2 and a processing chamber 1 such that all microwaves

irradiated towards the inside of the chamber 1 are introduced through the slots of the slot antenna 6 and the top plate 2 [e.g. Fig. 1 and para. 0027-0030).

Therefore it would have been obvious to one of ordinary skills in the art at the time of the invention to provide the apparatus configuration such that all microwaves irradiated towards the inside of the chamber are introduced through the slots of the slot antenna 6 and the top plate as taught by Ohmi et al in the apparatus of Kazumi et al in view of Mabuchi et al and Chen et al to obtain uniform electromagnetic field all over the space in the processing chamber.

Conclusion

Applicant's amendment necessitated the new ground(s) of rejection presented in this Office action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

Any inquiry concerning this communication or earlier communications from the examiner should be directed to RAKESH K. DHINGRA whose telephone number is (571)272-5959. The examiner can normally be reached on 8:30 -6:00 (Monday - Friday).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Parviz Hassanzadeh can be reached on (571)-272-1435. The fax phone number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

/Rakesh K Dhingra/
Examiner, Art Unit 1792

/K. M./
Primary Examiner, Art Unit 1792